POLLEN SIZE OF HEDYOTIS CAERULEA (RUBIACEAE) IN RELATION TO CHROMOSOME NUMBER AND HETEROSTYLY

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Darwin (1877) observed that the Rubiaceae contain a much larger number of heterostyled genera than any other family, a fact borne out by nearly one hundred years of additional observations (Vuilleumier, 1967). Among the numerous rubiaceous taxa he examined, Darwin noted that in *Hedyotis* (*Houstonia*) *caerulea* (L.) Hooker the pollen grains from the short-styled or "thrum" flowers were larger in diameter than those from the long-styled or "pin" flowers by a ratio of as much as 100 (thrum) to 72 (pin) after soaking in water. In Darwin's sample of *H. caerulea* about 80 percent of the pollen was heteromorphic, while the remainder was similar in size regardless of style type. These observations proved generally applicable: pollen from thrum flowered plants was larger than pollen from pin flowered plants whenever there was a difference in pollen size.

In a more detailed study of heterostyly in *Oldenlandia umbellata* L., a species allied to *Hedyotis caerulea* and often placed in the same genus, Bahadur (1963) found the mean volume of pollen grains from thrum flowers to be greater (ratio about 100:79) than that of the pin pollen, as anticipated, but he also observed a wide variation in pollen size in the two flower types in different populations. In fact the overlap in size ranges was such that approximately 70 percent of the pollen could not be differentiated by size alone.

In other genera of the Rubiaceae, Bremekamp (1963) observed that of nine species of *Mapouria* seven had larger thrum pollen than pin pollen by a ratio of 100:82, but two species showed no difference in pollen size between flower

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types. He found similar results for *Psychotria* and, like Darwin, concluded that in heterostylous taxa pollen from the thrum flower is, as a rule, larger than pollen from the pin flower. But he also concluded that this difference is not always present, at least in the Rubiaceae.

I wish to consider here a phenomenon related to pollen size which has recently proved widespread among the Hedyotideae, namely, autoploidy. This phenomenon was unknown to Darwin and was not investigated by Bahadur or Bremekamp. For example, Lewis (1964, 1966) reports three cytotypes for *Oldenlandia corymbosa* L., in which the diploid race has significantly smaller pollen than the tetraploid and hexaploid races. But *O. corymbosa* is homostylous. What relation might there be between pollen size and ploidy level in heterostylous species having several chromosomal races?

Hedyotis caerulea is an ideal species for such a study; it has widespread diploid and tetraploid races (Lewis & Terrell, 1962) and is heterostylous. Consequently, flowers from herbarium sheets representing three collections of known diploid number and two collections of known tetraploid number were selected for study. Whole flowers were acetolyzed and pollen grains were mounted in glycerine jelly for measurement of equatorial and polar axes. Either 50 or, more often, 100 grains per flower were measured. The specimens used and my results are summarized in Tables 1 (diploid plants) and 2 (tetraploid plants).

Pollen of *Hedyotis caerulea* is 3-colporate with a coarsely reticulate exine (Figures 14, 15, in Lewis, 1965). In the diploid plants examined, thrum pollen is usually larger than pin pollen, i.e., the range of means $\overline{X} = 28.6\text{-}30.9$ μm (equatorial E) and $\overline{X} = 27.4\text{-}28.6$ μm (polar P), in contrast to $\overline{X} = 23.1$ μm (E) and $\overline{X} = 22.0$ μm (P) for pollen from pin flowers (*Lewis* 5605). By averaging the equatorial and polar means for each floral type the single pin pollen sample was smaller by ratios of 100:81 and 100:76 when compared with the two thrum samples. But pollen from thrum and pin flowers of *Lewis* 5613 did

Table 1.

Pollen size of the diploid race of *Hedyotis caerulea* in relation to heterostyly.

Thrum (short styled)		Pin (long styled)	
5605[1]:	28.6μm ± 1.4[2] (E) & 27.4μm ± 1.5[2] (P)	*5605*:	23.1μm ± 1.4 (E) & 22.0μm ± 2.0 (P)
3393:	30.9μm ± 2.8 (E) & 28.6μm ± 2.7 (P)		
5613:	25.2μm ± 1.7 (E) & 23.7μm ± 2.7 (P)	*5613*:	25.1μm ± 2.0[2] (E) & 25.8μm ± 2.1[2] (P)

[1]Collections (with localities): *Lewis* 5605 (Kentucky: Metcalf Co., 3.1 miles E of Wisdom, MO); *Terrell & Barclay* 3396 (Alabama: Talladega Co., 2-3 miles W of Talladega Co.-Clay Co. Line, US); *Lewis* 5613 (Arkansas: Clark Co., 2.4 miles SE of Alpine, SMU).

[2]Based on N = 50, others N = 100.

Table 2.

Pollen size of the tetraploid race of *Hedyotis caerulea* in relation to heterostyly.

Thrum (short styled)		Pin (long styled)	
3663[1]:	28.7μm ± 1.8[2] (E) & 30.2μm ± 1.6 (P)	*3663*:	23.9μm ± 1.9 (E) & 21.9μm ± 1.6 (P)
3668:	30.7μm ± 1.6 (E) & 32.1μm ± 1.7 (P)		

[1]Collections (with localities): *Terrell* 3663 (Connecticut: Tolland Co., 3 miles S of Rockville, US); *Terrell* 3668 (Vermont: Windham Co., 2 miles W of Brattleboro, US).

[2]All N = 100.

not differ significantly in size: the thrum:pin ratio was 100:104, or about equal (Table 1).

In autotetraploid plants, pollen of thrum flowers was larger than that of pin flowers, *viz.*, 100:78 (*Terrell* 3663:3663) and 100:73 (*Terrell* 3668:3663), but in approximately the same proportions and of similar size as the pollen of typical diploid plants. This contrasts to the increase in size of pollen of many tetraploids and in the closely allied but homostylous *Oldenlandia corymbosa*. Is the need for larger pollen grains among polyploids already accounted for by the typically larger grains of thrum flowers?

SUMMARY

1. Pollen from thrum flowers is typically larger than pollen from pin flowers regardless of ploidy, although for one diploid population pollen was nearly equal in size.

2. The relative size differences between pollen from thrum and pin flowers is the same whether of diploid or of tetraploid origin.

3. Pollen from diploid plants is equivalent in size to pollen of tetraploid plants in *Hedyotis caerulea*. The usually larger size of pollen grains among polyploids is not characteristic of heterostylous infraspecific polyploids.

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